BEST AVAILABLE COPY

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 627 481 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
09.09.1998 Bulletin 1998/37

(51) Int Cl.[6]: **C09K 7/06**

(21) Application number: **94108195.2**

(22) Date of filing: **27.05.1994**

(54) **Invert drilling fluids**

Invertemulsionsbohrspülungen

Emulsions inverses de forage

(84) Designated Contracting States:
BE DE DK FR GB NL

(30) Priority: **01.06.1993 US 69468**

(43) Date of publication of application:
07.12.1994 Bulletin 1994/49

(73) Proprietor: **AMOCO CORPORATION**
Chicago, IL 60601 (US)

(72) Inventors:
- **Dawson, Raymond Bruce**
Baton Rouge, LA 70810 (US)
- **Carpenter, Joel Francis**
Baton Rouge, LA 70808 (US)

(74) Representative: **Sandmair, Kurt, Dr. Dr.**
Patentanwälte
Schwabe, Sandmair, Marx
Stuntzstrasse 16
81677 München (DE)

(56) References cited:

EP-A- 0 134 173	EP-A- 0 325 466
EP-A- 0 369 320	EP-A- 0 449 257
US-A- 4 282 392	US-A- 4 508 628
US-A- 4 587 368	US-A- 5 096 883

EP 0 627 481 B1

Printed by Jouve, 75001 PARIS (FR)

Description

The invention relates generally to invert drilling fluids and more specifically to environmentally friendly drilling fluids whose oil phase includes linear alpha-olefins having from 14 to 30 carbon atoms.

Historically, first crude oils, then diesel oils and, most recently, mineral oils have been used in formulating invert drilling fluids (oil based muds). Due to problems of toxicity and persistence which are associated with these oils, and which are of special concern in off-shore use, the industry is developing drilling fluids which use "pseudo-oils" for the oil phase. Examples of such oils are fatty acid esters and branched chain synthetic hydrocarbons such as polyalphaolefins. Fatty acid ester based oils have excellent environmental properties, but drilling fluids made with these esters tend to have lower densities and are prone to hydrolytic instability. Polyalphaolefin based drilling fluids can be formulated to high densities, have good hydrolytic stability and low toxicity. They are, however, somewhat less biodegradable than esters, they are expensive and the fully weighted, high density fluids tend to be overly viscous. U.S. Patent 5,096,883 discloses the use of such branched chain synthetic, hydrogenated oils which have the advantage, over most natural petroleum base oils, of being considered "non-toxic" in that they pass the standard "Ninety-Six Hour Static Bioassay" test for mortality of mysid shrimp. The toxicity of natural oils is indicated to be due to the presence of aromatics and n-olefins in such oils.

US-A-4 508 628 discloses a straight chain paraffine-containing base oil for water in oil emulsions used in drilling into rock formations in the production of crude oil and natural gas. The specific problem addressed by this reference is the provision of environmentally safe formulations for fast drilling in ofshore formations. The solution of this specific problem is the use of paraffines with low aromatics content as the oil phase in these formulations due to their low toxicity.

EP-A-0 369 320 provides formulations for cutting and grinding plastics and metals to improve surface detergency, to prevent rust and to enhance wear resistance. The disclosed formulations are lubricating oil compositions having a content of straight chain olefins between 6 and 40 carbon atoms. The document is, however, not related to drilling muds.

We have now found that less expensive drilling fluids having excellent technical and environmental properties can be formulated by using linear alpha-olefins (n-olefins) as a part of or all of the base oil phase. Contrary to the suggestion in U.S. 5,096,883, the linear α-olefins having carbon numbers of C_{14} and above were found to have a sufficiently low toxicity so as to pass the mysid shrimp toxicity testing standards.

In accordance with this invention there is provided an invert drilling fluid which comprises a water-in-oil emulsion which includes (a) at least 50 volume percent of a low toxicity base oil, said oil having a LC_{50} (SPP; mysid shrimp; 96 h acute toxicity test) in NPDES standard, greater than 30,000 parts per million and (b) at least one additive selected from the group consisting of emulsifiers, viscosifiers, weighing agents, oil wetting agents and fluid loss preventing agents, at least 25 volume percent of the base oil content of the drilling fluid being one or more linear alpha-olefins having from 14 to 30 carbon atoms.

Also provided is a method of lubricating a drill pipe when drilling a well, which method comprises circulating an invert drilling fluid throughout a borehole while simultaneously rotating a string of drill pipe having a drill bit on its lower end in contact with the bottom of the base hole so as to reduce the friction between the pipe and the sides of the borehole and to remove cuttings from the borehole, wherein said invert drilling fluid comprises a water-in-oil emulsion which includes (a) at least 50 volume percent of a low toxicity base oil, said oil having a LC_{50} (SPP; mysid shrimp; 96 h acute toxicity test) in NPDES standard, greater than 30,000 parts per million and (b) at least one additive selected from the group consisting of emulsifiers, viscosifiers, weighing agents, oil wetting agents and fluid loss preventing agents, at least 25 weight percent of the base oil content of the drilling fluid being one or more linear alpha-olefins having from 14 to 30 carbon atoms.

Invert drilling fluids contain at least 50 volume %, and typically 65 to 95 volume %, of a base oil as the continuous phase, no more than 50 volume % of water, and various drilling fluid additives such as emulsifiers, viscosifiers, alkalinity control agents, filtration control agents, oil wetting agents and fluid loss preventing agents. The base oils usually have kinematic viscosities of from 0.4 to 6.0 mm²/s at 100°C. According to this invention, at least 25 volume percent and, preferably, 75 volume percent or more of the base oil comprises one or more linear alpha-olefins having from 14 to 30 carbon atoms and, preferably, from 14 to 20 carbon atoms. The preferred linear alpha-olefins and mixtures thereof, such as C_{14}, C_{14-16}, C_{14-24}, and C_{16-18}, are commercially available from Ethyl Corporation. Such alpha-olefin products are derived from Ziegler chain growth and may contain up to 40 wt. percent, based on the total olefin content, of vinylidene and/or linear internal olefins.

Using the linear alpha-olefins has the advantage of lowering the viscosity of the mud to provide improved pumpability in use when compared to, for example, muds which use polyalphaolefin oils (PAO's) such as hydrogenated 1-decene dimer, whose kinematic viscosity of 1.8 mm²/s at 100°C is higher than optimum. In contrast, the 100°C viscosities C_{14} to C_{20} linear alpha-olefins range from about 0.85 to 2.85 mm²/s. The linear alpha-olefins also have better biodegradability compared to the PAO's which have a branched chain structure. The linear alpha-olefins can be used either alone or in combination with other low-toxicity base oils such as, for example, low-toxicity mineral oils, esters and PAO's to improve the performance of the drilling fluid and/or lower costs.

The physical and environmental properties of some linear alpha-olefin (LAO) oils, and mixtures of the linear alpha-olefin oils with other low toxicity base oils, compared to two low toxicity mineral base oils and a PAO base oil, are reported in Table I wherein the percentages of each oil in the base oil are in volume percent.

TABLE I

OIL							
Property	C_{14} LAO[1]	25% $C_{16\text{-}18}$ LAO[2]-75% PAO[3]	50% $C_{16\text{-}18}$ LAO[2]-50% PAO[3]	75% $C_{16\text{-}18}$ LAO[2]-25% PAO[3]	PAO[3,4]	Clairsol 350M[5] Oil	DF-1[6] Oil
Visc. @ 40°C (mm^2/s)	1.87	4.48	3.90	3.44	5.5	1.80	1.71
Vis. @ 100°C (mm^2/s)	0.87	1.60	1.48	1.39	1.8	0.84	0.81
Pour Point (°C)	-18	-18	-18	-9	<-65	-39	-42
Flash Point (°C) closed cup	107	146	145	148	155	76	75
Biodegradability (%) by CEC L33 T82	99	not tested	not tested	not tested	91	90	64
Toxicity: Microtox EC_{50} (SPP)	NR[7]	NR	NR	NR	NR	32,803	>49,500

1 Typically about 95% wt C_{14} with 80 mol % minimum linear alpha-olefin
2 Typically about 55/35/10 % by wt $C_{16}/C_{18}/C_{20}$ with 60 mol % minimum linear alpha-olefin
3 ETHYLFLO® 162 polyalphaolefin from 1-decene
4 Properties are product specification
5 "Low-Toxicity" mineral oil
6 "Low-Toxicity" mineral oil
7 No toxic response detected

It can be seen from the data reported in Table I that the linear alpha-olefin oils have excellent toxicity and aquatic biodegradability properties. Their physical properties are suitable for drilling fluids and the flash points at comparable

viscosities are superior to low-toxicity mineral oils.

The CEC (Coordinating European Council) L33 T82 protocol was developed to determine the persistence of 2-stroke outboard engine oil in aquatic environments. In recent years, results from this test have been applied more broadly. The test is fast becoming a standard for aquatic biodegradability for water insoluble materials. Note that this test is not a test of "ready biodegradability" but "comparative biodegradability." These terms are tightly defined by regulatory bodies.

The CEC L33 T82 test procedure is summarized as follows: Test flasks, together with poisoned flasks, (each in triplicate) containing mineral medium, test oil and inoculum are incubated for 0 to 21 days. Flasks containing calibration materials in the place of the test oil are run in parallel. At the end of the incubation times, the contents of the flasks are subjected to sonic vibration, acidified, and extracted with CCl_4 or R113. The extracts are then analyzed by Quantitative IR Spectroscopy, measuring the maximum absorption of the CH_3-band at 2930 cm^{-1}. The biodegradability is expressed as the % difference in residual oil content between the test flasks and the respective poisoned flasks at day 21.

The Microtox EC_{50} Standard Particulate Phase (SPP) test procedure is summarized as follows: Bioluminescent bacteria are exposed to progressively increasing concentrations of the test article. The calculated concentration at which their light emissions are decreased by 50% is referred to as the EC50 or the Effective Concentration 50. SPP is the preferred EPA method of preparing drilling fluids for toxicity assays. The drilling fluid is diluted 1:9 in artificial sea water, mixed for 5 minutes, pH adjusted, and then allowed to settle. The aqueous phase is treated as the undiluted test article.

Table II provides additional toxicity results for drilling muds, which contain 10% base oil in EPA's Generic Mud #7, according to the 96 hour LC_{50} mysid shrimp acute toxicity test wherein the percentages of each oil in the base oil are in volume percent.

The NPDES (National Pollutant Discharge Elimination System) standard for discharge into the Gulf of Mexico is an LC_{50} > 30,000 ppm (SPP, mysid shrimp, 96-hour acute toxicity). Drilling muds which meet this standard are considered to be non-toxic.

TABLE II

96-Hour LC_{50} in Mysidopsis bahia[3] (in ppm of the SPP)	
Oil	LC_{50}
75% E162 PAO 25% $C_{16}C_{18}$ LAO	>480,000
50% E162 PAO 50% $C_{16}C_{18}$ LAO	289,000
25% E162 PAO 75% $C_{16}C_{18}$ LAO	213,000
C_{14} LAO	44,700
Clairsol 350 M Oil[4]	8,600
$C_{12}C_{26}$ LAO[1,4]	27,200
$C_{12}C_{14}$ LAO[2,4]	19,500

[1] Typically about 3/28/28/23/18 wt. % $C_{10}/C_{12}/C_{14}/D_{16}/C_{18+}$ with 15 mol % linear α-olefin

[2] Typically about 62/37/1 wt. % $C_{12}/C_{14}/C_{16}$ with 87 mol % linear α-olefin

[3] The mud tested is 10% Base Oil/90% EPA Generic Mud #7

[4] for comparison

As shown in the data presented in Table II, the toxicities of comparison muds made with the mineral oil Clairsol 350 M oil, and linear alpha-olefin oils which contained material having less than 14 carbon atoms, e.g. $C_{12}C_{26}$, and $C_{12}C_{14}$ mixtures failed to meet > 30,000 ppm SPP standard established by NPDES for ocean disposal.

Besides the oil phase, the drilling fluid of the invention has a water phase of up to 50 volume percent, (preferably about 5 to 35 volume percent) which contains up to 35 to 38 wt. %, (preferably about 20 to 35 wt. %) of sodium or calcium chloride. The water in oil emulsion is formed by vigorously mixing the base oil and oil together with one or more emulsifying agents. Various suitable emulsifiers are known in the art and include, for example, fatty acid soaps, preferably calcium soaps, polyamides, sulfonates, triglycerides, and the like. The fatty acid soaps can be formed in

situ by the addition of the desired fatty acid and a base, preferably lime. The emulsifiers are generally used in amounts of from 1 to 8 kilograms per cubic meter of drilling fluid.

The drilling fluids also include, as known in the art, one or more additives such as viscosifiers, weighing agents, oil wetting agents and fluid loss preventing agents to enable the fluids to meet the needs of particular drilling operations. The additives function to keep cutting and debris in suspension, provide the required viscosity, density and additive wetting properties to the fluid, and prevent the loss of liquids from the fluid due to the migration of the liquids into the formations surrounding the well bore.

Clay and polymer viscosifiers such as, for example, bentonite and attapugite (which are sometimes reacted with quarternary ammonium salts), polyacrylates, cellulose derivatives, starches, and gums can be used in amounts of from 0.5 to 5 kilograms per cubic meter of drilling fluid.

The density of the drilling fluid can be increased by using weighing agents such as barite, galena, iron oxides, siderite and the like, to give densities ranging from 950 to 2400 kilograms per cubic meter of drilling fluid.

In order to assist in keeping solid additives in suspension in the drilling fluid, oil wetting agents, such as lecithin or organic esters of polyhydric alcohols, can be added in amounts of up to 4 kilograms per cubic meter of drilling fluid.

Fluid loss agents, such as organophilic humates made by reacting humic acid with amides of polyalkylene polyamines, act to coat the walls of the bore hole and are used in amounts of up to 7 kilograms per cubic meter of drilling fluid.

The invention is further illustrated by, but is not intended to be limited to, the following example.

Example 1

Four oil base (invert mud) drilling fluids were formulated using various linear alpha-olefin (LAO) containing base oils according to the following formulation:

Base Oil, mL	262
30% aqueous $CaCl_2$, mL	88
VERSAMUL®, g emulsifier [1,4]	3
VERSAWET®, g wetting agent [2,4]	4
VG-6®, g viscosifier [3,4]	5
Lime, g	10

[1] VERSAMUL® is a blend of emulsifiers, wetting agents, gellants, and fluid stabilizing agents. It requires the addition of lime which affords a calcium soap. It is a primary additive in "conventional" invert mud systems.

[2] VERSAWET® is a wetting agent, based on fatty acids.

[3] VG-69® is a viscosifier and gelling agent. It is a bentonite-based organophilic clay.

[4] Products of MI Drilling Fluids Co.

A finished invert mud would also contain enough barite to give the density needed for a particular bore hole. The characteristics of the formation through which the bore hole is drilled would also dictate whether the mud would require a fluid loss control agent.

The properties of the drilling fluids are reprinted in Table III below wherein the percentage of each oil in the base oil are in volume percent. Although the formulations were not optimized, the linear alpha-olefin containing oils formed stable emulsions, and each responded to the viscosifier.

TABLE III

Testing of Simple Invert Muds Formulated with Linear Alpha-Olefin (LAO) Oils

FLUID	C_{14}LAO[1]		75% PAO[3] 25% $C_{16\text{-}18}$ LAO[2]		50% PAO[3] 50% $C_{16\text{-}18}$ LAO[2]		25% PAO[3] 75% $C_{16\text{-}18}$ LAO[2]	
Hot Rolled?	I[4]	HR[5]	I	HR[5]	I	HR[5]	I	HR[5]
600 rpm Dial Reading[6]	10	11	20	25	21	22	19	20
300 rpm Dial Reading	6	6	11	13	11	11.5	10	10.5
200 rpm Dial Reading	4	4	5.25	8.5	8	8	7.5	7.5
100 rpm Dial Reading	2.25	2.25	3.75	4.75	4	4	3.5	3.75
6 rpm Dial Reading	0.75	0.75	0.5	1	0.5	0.75	0.75	0.75
3 rpm Dial Reading	0.75	0.75	0.5	0.75	0.5	0.75	0.75	0.75
Plastic Viscosity, cp (mPas)	4	5	9	12	10	10.5	9	9.5
Yield Point, (lb/100 ft^2) kPa	(2)9.58	(1)4.79	(2)9.58	(1)4.79	(1)4.79	(1)4.79	(1)4.79	(1)4.79
Gel Strength, (lb/100 ft^2) kPa	(1/1)4.79/4.79	(1/1)4.79/4.79	(1/1)4.79/4.79	(1/1)4.79/4.79	(1/1)4.79/4.79	(0/1)0/4.79	(1/1)4.79/4.79	(1/1)4.79/4.79
Electrical Stability, V	173	275	281	272	244	230	228	291

1 Typically about 95% wt C_{14} with 80 mol % minimum linear alpha-olefin
2 Typically about 55/35/10 % by wt $C_{16}/C_{18}/C_{20}$ with 60 mol % minimum linear alpha-olefin
3 ETHYLFLO® 162 polyalphaolefin from 1-decene
4 Initial value before hot-rolling
5 Hot rolled at 225°F (107.2°C for 16 hours)
6 Fann Viscometer dial reading

Claims

1. An invert drilling fluid which comprises a water-in-oil emulsion which includes (a) at least 50 volume percent of a low toxicity base oil which meets the National Pollutant Discharge Elimination System standard of having an LC_{50} of greater than 30,000 parts per million of the Standard Particulate Phase test procedure for mysid shrimp at 96-hour acute toxicity, and (b) at least one additive selected from the group consisting of emulsifiers, viscosifiers, weighing agents, oil wetting agents and fluid loss preventing agents, at least 25 volume percent of the base oil content of the drilling fluid being one or more linear alpha-olefins which have from at least 14 and up to 30 carbon atoms and which may contain up to 40 wt.% based on the total olefin content, of vinylidene and/or linear internal olefins.

2. The fluid of Claim 1 wherein said linear alpha-olefins have from at least 16 and up to 20 carbon atoms and at least 75 volume percent of the base oil content is one or more linear alpha-olefins.

3. The fluid of Claim 1 in which the base oil comprises one or more linear alpha-olefins and a hydrogenated polyalphaolefin oil.

4. The fluid of Claim 1 wherein said fluid contains from 65 to 95 volume % base oil and said base oil has a kinematic viscosity at 100°C of from 0.4 to 6.0 mm^2/s at 100°C.

5. The fluid of Claim 1 wherein said fluid contains from 1 to 8 kilograms per cubic meter of fluid of an emulsifier.

6. A method of lubricating a drill pipe when drilling a well, which method comprises circulating an invert drilling fluid throughout a borehole while simultaneously rotating a string of drill pipe having a drill bit on its lower end in contact with the bottom of the base hole so as to reduce the friction between the pipe and the sides of the borehole and to remove cuttings from the borehole, wherein said invert drilling fluid comprises a water-in-oil emulsion which includes (a) at least 50 volume percent of a low toxicity base oil which meets the National Pollutant Discharge Elimination System standard of having an LC_{50} of greater than 30,000 parts per million of the Standard Particulate Phase test procedure for mysid shrimp at 96-hour acute toxicity, and (b) at least one additive selected from the group consisting of emulsifiers, viscosifiers, weighing agents, oil wetting agents and fluid loss preventing agents, at least 25 volume percent of the base oil content of the drilling fluid being one or more linear alpha-olefins which have from at least 14 and up to 30 carbon atoms and which may contain up to 40 wt.% based on the total olefin content, of vinylidene and/or linear internal olefins.

7. The method of Claim 6 wherein said linear alpha-olefins have from at least 16 and up to 20 carbon atoms and at least 75 volume percent of the base oil content is one or more linear alpha-olefins.

8. The method of Claim 6 in which the base oil comprises one or more linear alpha-olefins and a hydrogenated polyalphaolefin oil.

9. The method of Claim 6 wherein said fluid contains from 65 to 95 volume % base oil and said base oil has a kinematic viscosity at 100°C of from 0.4 to 6.0 mm^2/s at 100°C.

10. The method of Claim 6 wherein said fluid contains from 1 to 8 kilograms per cubic meter of fluid of an emulsifier.

11. The fluid of Claim 1 wherein the aforesaid one or more linear alpha-olefins are alpha-olefin products derived from Ziegler chain growth.

12. The fluid of Claim 11 wherein the aforesaid alpha-olefin products contain at least 60 wt percent of linear alpha-olefins, based on the total olefin content.

13. The method of Claim 6 wherein the aforesaid one or more linear alpha-olefins are alpha-olefin products derived from Ziegler chain growth.

14. The method of Claim 13 wherein the aforesaid alpha-olefin products contain at least 60 wt percent of linear alpha-olefins, based on the total olefin content.

Patentansprüche

1. Invertbohrfluid, enthaltend eine Wasser-in-Öl-Emulsion, die (a) mindestens 50 Vol.-% eines Basisöls von geringer Toxizität, das die Vorgaben des "National Pollutant Discharge Elimination System" mit einem LC_{50} von mehr als 30.000 ppm des "Standard Particulate Phase" Testverfahrens für Mysid-Krabben bei einer akuten Toxizität von 96 Stunden erfüllt, und (b) mindestens ein Additiv aus der aus Emulgatoren, Mitteln zur Erhöhung der Viskosität, Streckmitteln, Ölbenetzungsmitteln und Mitteln zur Verhinderung des Fluiditätsverlusts enthält, wobei ein oder mehrere lineare α-Olefine, die mindestens 14 bis zu 30 Kohlenstoffatome aufweisen und bezogen auf den Gesamtolefingehalt bis zu 40 Gew.-% Vinyliden und/oder lineare Olefine mit innenliegenden Doppelbindungen enthalten, mindestens 25 Vol.-% des Basisölgehalts der Bohrflüssigkeit ausmachen.

2. Fluid nach Anspruch 1, in dem die linearen α-Olefine mindestens 16 bis zu 30 Kohlenstoffatome aufweisen und mindestens 75 Vol.-% des Basisölgehalts aus einem oder mehreren linearen A-Olefinen bestehen.

3. Fluid nach Anspruch 1, in dem das Basisöl ein oder mehrere lineare α-Olefine und ein hydriertes Poly-α-Olefinöl enthält.

4. Fluid nach Anspruch 1, das 65 bis 95 Vol.-% Basisöl enthält, welches bei 100°C eine kinematische Viskosität von 0,4 bis 6,0 mm^2/s aufweist.

5. Fluid nach Anspruch 1, das pro Kubikmeter Fluid 1 bis 8 kg Emulgator enthält.

6. Verfahren zum Schmieren einer Bohrrohrleitung beim Bohren eines Bohrlochs, bei dem man ein Invertbohrfluid durch ein Bohrloch zirkulieren läßt, während man gleichzeitig ein Stück Bohrrohrleitung mit einem Bohrteil am unteren Ende, das sich in Kontakt mit dem Boden des Basislochs befindet, rotieren läßt, um die Reibung zwischen der Rohrleitung und den Seiten des Bohrlochs zu verringern und Abtragungen aus dem Bohrloch zu entfernen, wobei das Invertbohrfluid eine Wasser-in-Öl-Emulsion enthält, die (a) mindestens 50 Vol.-% eines Basisöls von geringer Toxizität, das die Vorgaben des "National Pollutant Discharge Elimination System" mit einem LC_{50} von mehr als 30.000 ppm des "Standard Particulate Phase" Testverfahrens für Mysid-Krabben bei einer akuten Toxizität von 96 Stunden erfüllt, und (b) mindestens ein Additiv aus der aus Emulgatoren, Mitteln zur Erhöhung der Viskosität, Streckmitteln, Ölbenetzungsmitteln und Mitteln zur Verhinderung des Fluiditätsverlusts enthält, wobei ein oder mehrere lineare α-Olefine, die mindestens 14 bis zu 30 Kohlenstoffatome aufweisen und bezogen auf den Gesamtolefingehalt bis zu 40 Gew.-% Vinyliden und/oder lineare Olefine mit innenliegenden Doppelbindungen enthalten, mindestens 25 Vol.-% des Basisölgehalts der Bohrflüssigkeit ausmachen.

7. Verfahren nach Anspruch 6, bei dem die linearen α-Olefine mindestens 16 bis zu 30 Kohlenstoffatome aufweisen und mindestens 75 Vol.-% des Basisölgehalts aus einem oder mehreren linearen α-Olefinen bestehen.

8. Verfahren nach Anspruch 6, bei dem das Basisöl ein oder mehrere lineare α-Olefine und ein hydriertes Poly-α-Olefinöl enthält.

9. Verfahren nach Anspruch 6, bei dem das Fluid 65 bis 95 Vol.-% Basisöl enthält, welches bei 100°C eine kinematische Viskosität von 0,4 bis 6,0 mm^2/s aufweist.

10. Verfahren nach Anspruch 6, bei dem das Fluid pro Kubikmeter 1 bis 8 kg Emulgator enthält.

11. Verfahren nach Anspruch 1, bei dem das oder die linearen α-Olefine von einem Ziegler-Kettenwachstum abgeleitete α-Olefinprodukte sind.

12. Fluid nach Anspruch 11, bei dem die α-Olefinprodukte bezogen auf den Gesamtolefingehalt mindestens 60 Gew.-% lineare α-Olefine enthalten.

13. Verfahren nach Anspruch 6, bei dem das oder die linearen α-Olefine von einem Ziegler-Kettenwachstum abgeleitete α-Olefinprodukte sind.

14. Verfahren nach Anspruch 13, bei dem die α-Olefinprodukte bezogen auf den Gesamtolefingehalt mindestens 60 Gew.-% lineare α-Olefine enthalten.

Revendications

1. Emulsion inverse de forage qui comprend une émulsion d'eau dans de l'huile qui inclut (a) au moins 50% en volume d'une huile de base de faible toxicité, qui rencontre le standard du système national d'élimination des décharges polluantes (National Polluant Discharge Elimination System) qui consiste à avoir une LC_{50} supérieure à 30 000 parties par million selon le procédé de test de phase standard particulaire (Standard Particulate Phase) pour les crevettes mysid à une toxicité aiguë de 96 heures, et (b) au moins un additif choisi parmi le groupe consistant en émulsifiants, agents de viscosité, agents de charge, agents mouillants des huiles et agents de prévention de perte de liquide, une part d'au moins 25% en volume de la teneur en huile de base de l'émulsion de forage étant constituée par une ou plusieurs alpha-oléfines linéaires ayant au moins 14 et jusqu'à 30 atomes de carbone et qui peut contenir jusqu'à 40% en poids, par rapport à la teneur totale en oléfine, de vinylidène et/ou d'oléfines linéaires internes.

2. Emulsion selon la revendication 1, dans laquelle lesdites alpha-oléfines linéaires ont au moins 16 et jusqu'à 20 atomes de carbone et une ou plusieurs alpha-oléfines linéaires forment au moins 75% en volume de la teneur en huile de base.

3. Emulsion selon la revendication 1, dans laquelle l'huile de base comprend une ou plusieurs alpha-oléfines linéaires et une huile de poly-alpha-oléfine hydrogénée.

4. Emulsion selon la revendication 1, dans laquelle ladite émulsion contient 65 à 95% en volume d'huile de base et ladite huile de base a une viscosité cinématique à 100°C de 0,4 à 6,0 mm^2/s à 100°C.

5. Emulsion selon la revendication 1, dans laquelle l'émulsion contient un émulsifiant à raison de 1 à 8 kg/m^3 d'émulsion.

6. Procédé de lubrification d'une tige de forage lors du forage d'un puits, procédé qui comprend la circulation d'une émulsion inverse de forage à travers un trou de forage tout en faisant tourner simultanément une rame de tige de forage ayant un foret sur son extrémité inférieure en contact avec le fond du trou de base de manière à réduire la friction entre la tige et les parois du trou de forage et à éliminer les débris provenant du trou de forage, dans lequel ladite émulsion inverse de forage comprend une émulsion d'eau dans de l'huile qui inclut (a) au moins 50% en volume d'une huile de base de faible toxicité, qui rencontre le standard du système national d'élimination des décharges polluantes (National Polluant Discharge Elimination System) qui consiste à avoir une LC_{50} supérieure à 30 000 parties par million selon le procédé de test de phase standard particulaire (Standard Particulate Phase) pour les crevettes mysid à une toxicité aiguë de 96 heures, et (b) au moins un additif choisi parmi le groupe consistant en émulsifiants, agents de viscosité, agents de charge, agents mouillants des huiles et agents de prévention de perte de liquide, une part d'au moins 25% en volume de la teneur en huile de base de l'émulsion de forage étant constituée par une ou plusieurs alpha-oléfines linéaires ayant au moins 14 et jusqu'à 30 atomes de carbone et qui peut contenir jusqu'à 40% en poids, par rapport à la teneur totale en oléfine, de vinylidène et/ou d'oléfines linéaires internes.

7. Procédé selon la revendication 6, dans lequel lesdites alpha-oléfines linéaires ont au moins 16 et jusqu'à 20 atomes de carbone et une ou plusieurs alpha-oléfines linéaires forment au moins 75% en volume de teneur en huile de base.

8. Procédé selon la revendication 6, dans lequel l'huile de base comprend une ou plusieurs alpha-oléfines linéaires et une huile de poly-alpha-oléfine hydrogénée.

9. Procédé selon la revendication 6, dans lequel l'émulsion contient 65 à 95% en volume d'huile de base et ladite huile de base a une viscosité cinématique à 100°C de 0,4 à 6,0 mm^2/s à 100°C.

10. Procédé selon la revendication 6, dans lequel l'émulsion contient un émulsifiant à raison de 1 à 8 kg/m^3 d'émulsion.

11. Emulsion selon la revendication 1, dans laquelle lesdites une ou plusieurs alpha-oléfines linéaires sont des produits d'alpha-oléfines dérivés de la croissance en chaîne de Ziegler.

12. Emulsion selon la revendication 11, dans laquelle lesdits produits d'alpha-oléfines contiennent au moins 60% en poids d'alpha-oléfines linéaires, par rapport à la teneur totale en oléfines.

13. Procédé selon la revendication 6, dans lequel lesdites une ou plusieurs alpha-oléfines linéaires sont des produits d'alpha-oléfines dérivés de la croissance en chaîne de Ziegler.

14. Procédé selon la revendication 13, dans lequel lesdits produits d'alpha-oléfines contiennent au moins 60% en poids d'alpha-oléfines linéaires, par rapport à la teneur totale en oléfines.